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The New York City Off-Hour Delivery Project: Lessons for City Logistics

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Abstract

The paper identifies and discusses the fundamental tenets that should guide planning and implementation of City Logistics projects, and the chief lessons learned from the off-hours delivery project conducted in New York City.

Keywords: City logistics; urban freight policy; off-hour deliveries

1. Introduction

The New York City off-hour delivery (OHD) program provides an interesting example of multi-stakeholder cooperation between public and private sector partners, community advocates, and trade organizations. Large and complex, the project required stakeholder collaboration to fully achieve its goals. Begun as a small research project in 2002, the original idea was transitioned into practice because of its potential economic and environmental impacts. It is estimated that, if fully funded, the program could switch in excess of 20% of the congested day hours freight traffic deliveries to the off-hours (between 7PM and 6AM). The impacts would be tremendous: $150-$200

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million/year in economic benefits associated with travel time savings, productivity increases, and sizable pollution reductions (e.g., 20.9% of OHD leads to reductions of: 202.7 metric tons (t) of CO, 40t of HC, 11.8t of NO_x, and 69.9 kg of PM_{10}) (Holguín-Veras, Ozbay, Komhauser, Brom, Iyer, Yushimito et al., 2011b). Recognizing these significant impacts, the City of New York adopted OHD as part of its sustainability plan (City of New York, 2011), and the United States' Federal Highway Administration decided to create their own program to foster OHD, based on the concept pioneered in NYC (Federal Highway Administration, 2012).

The path to implementation began when the project demonstrated how it could benefit all stakeholders: citizens and bicyclists would enjoy enhanced quality of life with less interference from deliveries; the urban economy would be improved by lower delivery costs; carriers would benefit from increased productivity; receivers would enjoy increased reliability; day-hour travellers would experience faster travel speeds; and with the use of low noise truck technologies, local communities would not be impacted by night noise. The research conducted enabled a concept design that addressed the needs and concerns of all parties. This gave stakeholders confidence that the proponents had thoroughly considered and would have solutions for all key issues.

While the OHD project is now widely recognized as a success, the road to implementation was not smooth. At various stages, potential participants and stakeholders showed lack of interest, scepticism, and even hostility. At the outset, the prevailing attitude of most city agencies was that urban freight operations were a private sector activity; one that they "should not mess with." On the private sector side, most carriers were in favour of the project because of the lower costs, though they realized that nothing would happen without the approval of receivers. Receivers, on the other hand, were content with the status quo (regular-hour deliveries), and saw no need to change. The carriers, who stood to benefit, do not generate enough profits from OHD to compensate the receivers for their extra costs. Thus, the urban freight system (UFS) was locked in a sub-optimal solution. Without public sector incentives to receivers in exchange for their participation in OHD, no change was possible. The lack of any history of cooperation between the public and private sectors was another obstacle to change, with uncertainty on both sides about whether "the other side" would do what was necessary to jumpstart the program. The carriers were unsure of the public sector's commitment to offering incentives to the receivers, and how long lasting that commitment would be. Meanwhile, some in the public sector were unsure whether the incentives would have the intended effect, and whether such intervention was even warranted.

This paper discusses the lessons learned during the OHD project, and the important role cutting-edge research can play in defining new paradigms of UFS. It identifies the most effective paths to achieving the desired goals: building coalitions of agents-of-change involving both private and public sector partners; pilot-testing as an external validation for research concepts; and the importance of defining implementation pathways for promising concepts, while also accounting for the complex political realities of modern urban environments. These lessons are framed in the dual contexts of the fundamental tenets that should guide sustainability efforts, and the market conditions that influence UFS participants' behaviour.

The paper has five sections: Section 2 addresses the tenets that should guide efforts to improve UFS's social performance; Section 3 summarizes the key economic factors that influence UFS behaviour; Section 4 elucidates the top lessons learned from the OHD project; and Section 5 considers the question of transferability. The Conclusions section synthesizes the paper's chief findings.

2. Fundamental Tenets

This section discusses the chief principles that, in the opinion of the authors, should guide City Logistic efforts. Taken together, these tenets provide a solid foundation for research, policies and programs that seek to advance UFS sustainability, now and in the future.

2.1. The importance and behavior change to foster sustainability

The quest for sustainability is fundamentally one of behaviour change, both short- and long-term. Central to the effort is public sector policy, combined with proactive engagement of the private sector, to transform UFS operations (the short-term) and the strategic decisions of firms (the long-term), towards increased sustainability,

quality of life, economic efficiency, and environmental justice. To achieve this, one needs to: (1) understand behaviour; (2) identify appropriate public sector policy measures; (3) identify the roles of the stakeholders in the execution of policy, and gain their cooperation; (4) assess the effectiveness of alternative policies; (5) identify pathways for implementation that account for the relative positions of the stakeholders; (6) test novel concepts; and (7) proceed to implementation, if appropriate.

To understand the behaviour of UFS agents one must assume that they are rational, guided by a desire to maximize their economic returns, given market and regulatory constraints. However, though it is safe to assume that an agent's behaviour and operations are guided by rational considerations, it is also safe to assume that there is room for improvement in those operations. Simply put, within the context that an agent operates—their constraints, value system, education and training levels, access to technology, and market pressures—they are doing their best. By modifying these constraints, and inducing carriers to consider such other aspects as sustainability, freight behaviour can be influenced for the better.

An understanding of behaviour is essential to identify policies to improve the UFS. A lack of understanding—about the problem and about how the UFS would respond to a proposed policy—can lead to ineffective efforts, loss of credibility, and numerous unintended effects. However, in terms of UFS operations—where most decisions are private transactions—city officials are often at a complete loss; unaware of how agents interact and how to improve the system. In this context, behavioural research helps identify the best means (programs/policies) to the desired ends (goals).

Key considerations in policymaking are the policy instrument to be used, and the strength of the corresponding policy stimulus. The combined use of stated preference data and behavioural discrete choice models has proven very useful in providing insights, as illustrated in Holguín-Veras, Silas, Polimeni & Cruz (2007), and Holguín-Veras, Silas, Polimeni & Cruz (2008). For instance, a city agency may decide to use parking pricing to foster a better allocation of curb space, which leads to the question of what the parking charge should be. If it is too low, it may fail to have any impact; if set too high, it may lead to underutilization of a public good, and significantly, probably justified opposition from users. Although city officials could set the charge by trial-and-error, doing so may lead to a lack of credibility, as users may perceive this as an indication that the officials do not know what they are doing.

Another important consideration is the policy's target, which is not trivial or necessarily straightforward, given the great heterogeneity in behaviours. In response to a policy measure, it is almost certain that the various industry sectors would respond very differently. Knowing in advance which sectors would respond and in what manner, could help with the design of differential policies that focus on specific industry segments. For instance, as shown in Holguín-Veras, Silas, Polimeni & Cruz (2007), that the receivers of food and retail products were found to be more sensitive to financial incentives than other sectors. Thus, it made sense to focus effort in these sectors, as opposed to targeting the broad population of receivers that would be less inclined to participate.

2.2. Policies that foster sustainability have to account for the selfish behavior of all involved

The politics of implementation and the durability of the public sector intervention must also be considered. A beneficial policy that is accepted and embraced by all stakeholders is likely to be better, in the long term, than an ideal policy that is bitterly opposed by influential groups. This is important to consider, as the multiplicity of agents involved in the UFS provides ample opportunities for change to be blocked or delayed. Such opposition could lead to the reversal of the original policy and a setback that could take years to recover from. Thus, coordinated efforts involving key stakeholders are bound to be more effective and longer lasting than unilateral public sector actions. The clever use of incentives and penalties could play a key role in ensuring that the majority of stakeholders benefit, or at least remain unchanged, from the implementation. Achieving this balance can smooth the way for implementation, engender political support, and open the door for further collaboration.

These principles were used very effectively in the OHD project. First, the concept hinged on the voluntary participation of companies, a request that conveyed to the private sector the message that city agencies were interested in working together, as opposed to acting unilaterally by imposing regulations. This laid a foundation for collaboration. Recognizing that receivers would accrue additional costs, the program proposed financial incentives

for them, which in turn garnered support from both receivers and their trade groups. Since noise at night could lead to significant community opposition, which might also derail implementation, the team adopted a proactive noise policy to ensure that the carriers conduct OHD without negatively impacting local communities. The net effect of these actions was to facilitate implementation.

3. Economic Foundations

This section focuses on the economic aspects considered when designing and implementing programs aimed at increasing UFS sustainability. Two important and frequently overlooked aspects are discussed: the economic interactions among the agents that participate in the UFS and the role played by market conditions.

3.1. Interactions among freight agents

Carrier behaviour is the interaction amongst the economic agents that produce and ship goods (producers and shippers) and those that receive the cargo (receivers). Although other agents are involved, the interactions amongst shippers, carriers, and receivers are the most important. Throughout the paper, the "shipper" is assumed to comprise both production and shipping functions; while the "carrier" is the agent that conducts the transportation activity. The latter includes both common carriers that sell transportation services in the market, and private carriers that only serve a parent or related venture. The word "supplier" refers to a super-agent that combines the shipping and transportation functions.

In most cases, carriers are the weakest agents, for economic reasons that originate in the deregulation of the trucking industry in most urban markets since the 1980s. Since entry barriers were lowered, the number of entrants to the carrier industry dramatically increased, particularly in those segments that use standard trucks without specialized equipment. The resulting over-supply puts downward pressure on rates and weakens the position of the carriers. The segments that use specialized equipment, e.g., construction trucks, are not similarly affected because the higher purchase price acts as a market barrier to potential entrants.

Shippers and receivers face a different situation. It is significantly more difficult to become a shipper or a receiver than it is to become a carrier; the initial investment is much higher. Potential shipper and receiver entrants need installations, equipment (and expensive urban land in the case of receivers) as well as the financial resources and time required to start operations. Aspiring carriers need only to purchase a truck to be in business. The relatively smaller number of shippers and receivers has market power when negotiating with the more numerous carriers. There are industry segments in which the carriers have some degree of market power: express deliveries, the construction industry, and others. Also, in cities and countries where the urban trucking industry is heavily regulated and the market is not perfectly competitive, carriers may have and exert more industry power. However, these cases seem to be the exception rather than the rule in urban freight markets.

Given the imbalance of power among carriers, shippers and receivers, a number of important decisions that are generally perceived to be the carriers' responsibility are heavily influenced—and in some cases, determined—by shippers or receivers. Two notable examples are freight mode choice, and the response of carriers to freight road pricing. Theory (McFadden, Winston & Boersch-Supan, 1986), empirical evidence (Holguín-Veras, 2002), and economic experiments (Holguín-Veras, Xu, de Jong & Maurer, 2011c) have proven that the most important factor in freight mode choice is the shipment size (a shipper's decision). In competitive markets, shippers and receivers (which one makes the choice depends on the balance of power between them) are free to select the shipment size that minimizes their total logistic costs (Holguín-Veras, Xu, de Jong & Maurer, 2011c; Combes, 2012). Once shippers/receivers select shipment size, the carriers decide on the appropriate mode/vehicles; their choice is conditioned/determined by the shippers/receivers' shipment size decision. In terms of carrier response to freight road pricing, it has been proven that the receiver is the key decision-maker concerning delivery times (Holguín-Veras, Silas, Polimeni & Cruz, 2007). The implication is that to understand and influence carrier behaviour, one must determine how to affect the behaviour of shippers and receivers. Moreover, these interactions do not take place in a vacuum; they are further determined by market conditions. This important topic is discussed next.

3.2. The role of market conditions

The commodity flows transported by freight vehicles are the physical manifestation of economic market transactions. The nature of the market and the prevailing regulatory framework play a key role in shaping UFS activity. In most cases, city agencies generally take a laissez faire approach, allowing shippers, carriers, and receivers to operate the system as they see fit. In other cases, city agencies have pursued regulatory approaches that, while implemented to remedy a perceived problem, often do not consider in great detail the market conditions that produce the problem. Many of these regulations are not based on any grounded understanding of the best ways to induce the desired behaviour change(s). In only a minority of cases are city agency decisions based on solid behavioural UFS research.

The most obvious way the market influences carrier behaviour is by placing constraints on their ability to price. One could identify three key market types that differ by the extent of pricing power they allow: monopoly, oligopoly, and the competitive market. The vast majority of carriers probably participates in a competitive market; followed by oligopolies; with monopolies being the rarest. The optimal prices for these markets are shown below (Varian, 1992; Holguín-Veras & Jara-Díaz, 1998). The reader should note that equations (1) and (3) could be obtained from (2) by making s_k equal to 1 and 0:

Monopoly: $$\frac{P - m(Q)}{P} = \frac{1}{|\eta|} \tag{1}$$

Oligopoly: $$\frac{P_k - m_k(Q_k)}{P_k} = \frac{s_k}{|\eta|} \tag{2}$$

Competitive market: $$P = m(Q) \tag{3}$$

Where: P is market price, $m(Q)$ is marginal cost, s_k is the market share of carrier k, and η is the elasticity.

These market types differ notably in terms of pricing power. In a monopoly, the carrier could charge a mark-up, bounded only by the customer's willingness to pay (the inverse of the price elasticity); the more inelastic the demand, the higher the mark-up above marginal cost. In an oligopoly, the carrier's ability to price depends on its market share and the customer's willingness to pay. The higher the market share and willingness to pay, the higher the mark-up the carrier can extract from the customer. In competitive markets, prices are equal to marginal costs, meaning that the carrier does not have power to price. These pricing behaviours have noteworthy implications in cost recovery, illustrated below. Note that total costs are equal to the summation of fixed and variable costs:

$$C_T(Q) = C_F + C_V(Q) \tag{4}$$

The average (ac) and marginal (m) costs are:

$$ac(Q) = \frac{C_F + C_V(Q)}{Q} \tag{5}$$

$$m(Q) = \frac{\partial\{C_F + C_V(Q)\}}{\partial Q} = \frac{\partial\{C_V(Q)\}}{\partial Q} \tag{6}$$

From equation (6), one could obtain:

$$C_V(Q) = \int_0^Q m(Q)dQ \tag{7}$$

Under monopolistic pricing, the carrier could charge above and beyond average costs, garnering significant

profits. At the other end of the spectrum, in competitive markets, carriers cannot recover the full costs of the operations. To see why, note that equation (5) is the minimum price the supplier must charge to be able to recover both fixed and variable costs. Consequently, pricing at marginal cost, as in equation (6), only recovers the variable cost of providing the service, as shown in equation (7). This is important because, in conditions of scale economies, like those that prevail in most freight markets (where increasing the output Q leads to lower average costs), the average cost is higher than marginal cost. Thus, carriers that participate in competitive markets cannot recover the fixed costs of their operations, and their assets gradually deteriorate until operations are no longer possible and they exit the market. Although one would expect that at some point the number of entrants would diminish, leading to a restoration of market power for carriers, there is no evidence of this happening. Becoming a trucker is one of the avenues of social ascent for blue collar workers. As a result of the "quasi-infinite" supply of carriers, the entrance of others more than compensates for the exit of any one small owner-operator who goes bankrupt. In an oligopoly, carriers with a large market share could price above average costs; while those with a small market share will find themselves in the same situation as in a competitive market, unable to recover the full costs of their operations.

The behaviour described is not a theoretical aberration; it has been confirmed by empirical evidence. After the 2001 Port Authority of New York and New Jersey's Time of Day Pricing Implementation, researchers found that only about 11% of the carriers could pass some of the toll costs on to the customers; and the remaining 89% had to absorb the toll costs to avoid upsetting their customers (Holguín-Veras, Wang, Xu, Ozbay, Cetin & Polimeni, 2006). As expected, the carriers who were able to pass on the toll costs were those belonging to industry segments with market power, such as carriers of stone/concrete, wood/lumber, food, electronics, and beverages (Holguín-Veras, 2008). Equally significant, about 70% of carriers cited "customer requirements" as the reason they could not change behaviour. In essence, the receivers used their market power to prevent carriers from changing delivery times (Holguín-Veras, Wang, Xu, Ozbay, Cetin & Polimeni, 2006).

4. Lessons Learned

This section summarizes the chief lessons learned during the off-hour delivery project.

4.1. Lesson #1: Make sure there is a market failure

A frequently overlooked but important policy principle is that public sector interventions are only justified when a market failure is preventing the economy from reaching its most efficient outcome. Market failures could be the result of: productive and allocative inefficiency, monopoly power, missing markets, incomplete markets, de-merit goods, externalities, lack of property rights, information failure, unstable markets, and inequality (Economics Online, 2012). The solution could be technical in nature, such as replacing polluting engines with cleaner ones, or could involve either pricing or regulations to ensure that the market failure is removed. A well-designed intervention would thus be introduced to lead the system to greater economic efficiency. However, if there is no market failure, public sector intervention could make things worse. Referred to in the literature as a "government failure," the inefficiency is introduced by the public sector decision (in contrast to a "market failure" produced by market forces).

In urban areas there are numerous situations involving freight activity, pedestrians, bicyclists, and communities that are market failures, typically relating to externalities produced by freight activity. When deciding how to address the problem, city agencies must carefully consider the potential impacts of the solution, as government failures are a decided risk. For instance, banning large trucks in congested areas—though beneficial for the area within the ban—could produce congestion and externalities in the regional networks as carriers have to use many small trucks to transport the same cargo that their large trucks once did (Qureshi, Taniguchi & Yamada, 2012; Holguín-Veras, Cruz & Ban, 2013a) (After such a ban in Sao Paulo, Brazil, a large company reported to the first author using 2.7 small trucks for each of the large trucks banned). Time-access restrictions for all trucks have been found to increase both carrier costs and freight traffic externalities (Quak & de Koster, 2009). In both cases, a government failure is likely for the simple reason that the private goal (minimization of private costs) is in

agreement with the social goal of minimizing truck travel in the networks. As a result, the imposition of large truck bans, or time access restrictions, could increase both private costs and externalities.

Establishing whether a market failure really exists requires: (1) proving that the most efficient outcome for the economy has not been reached; and (2) identifying the actual factor creating the failure (Holguín-Veras, 2011). Once the existence of a market failure has been established, the next step is to determine the most effective mechanism for its removal. In deciding how best to proceed, policy makers need to consider the implementation costs of the correction procedures. If the benefit of removing the market failure, either by pricing or regulation, is smaller than the corresponding incremental cost (including implementation costs) then it is better to remain with the status quo. For instance, a zero tolerance policy against parking violations may require large enforcement expenses, which may not be compensated for by the benefits in congestion reduction. In such a case, the zero-tolerance policy does not make economic sense.

In the OHD project, the first step was to find out if OHD is indeed the most efficient outcome for the economy. Using traffic simulations and the transportation planning model, different scenarios were tested. The results showed that the status quo (4-5% of OHD) is indeed suboptimal; the optimal participation level was estimated to be in the range of 14-21% (staffed OHD) (Holguín-Veras, Ozbay, Komhauser, Brom, Iyer, Yushimito et al., 2011b), and over 40% for unassisted OHD (Holguín-Veras, Marquis & Brom, 2012). These modalities differ in the costs to receivers. These results are consistent with Yannis, Golias & Antoniou (2006).

4.2. Lesson #2: Listen to and engage stakeholders in the solution of problems

To solve a problem that has been identified as a market failure, it is vital to engage and listen to the key stakeholders. Proper, honest engagement brings multiple benefits, as it: (1) may lead to confirmation or rejection of the hypothesis that there is a problem to be solved, or mitigated, by public sector intervention; (2) will provide the public sector with a thorough idea of the constraints and expectations of the various stakeholders; and, (3) will enable the public sector to chart implementation paths that have a better chance of succeeding. Developing and sustaining successful outreach is the core of such a process, and integral to creating a solid relation between the public and private sectors. If researchers and public agencies spend time to build relations with the private sector, to establish a minimum level of trust, and to clearly articulate why private sector input is needed to help shape public policy, their chances of success will increase.

Both public and private sectors need to feel that their points of views are being heard, and taken into account. When the public sector solicits the private sector's input and assistance to solve UFS problems, it is important that the public sector also collaborates with them to solve problems of particular interest to the industry. The public sector's willingness to change or modify a course in response to input from the private sector could foster a collaborative environment; as would the private sector's willingness to modify operations in response to public sector input. This back-and-forth collaborative environment can forge stronger policies.

It is always a challenge to secure the honest and timely feedback that the public sector needs to really understand private sector constraints and expectations. These tips may help:

1) **Try to get input from as many independent sources as possible**. In doing so, the authors found the operator' perspectives to be particularly insightful. However, since operators are busy running their businesses, they often cannot commit much time to speaking to policymakers and planners.
2) **Be mindful that the positions expressed are likely to represent only a portion of the industry**. This applies to both individual company spokespersons and leaders of trade groups. Even trade group leaders reflect the positions of their members, not necessarily those of the rest of the industry or of non-members. These trade group leaders are relatively easy to speak with, since interfacing with the public sector is part of their job. However, this ease may in turn lead to biased input and policy decisions, unless the public sector is more thorough and inclusive in their outreach.

A healthy outreach process leads to a public sector that is well informed of the concerns, expectations, and constraints of the private sector. This, in turn, enhances transportation policy makers' ability to implement change,

change that achieves the intended objectives with minimal political costs. Such an outreach process is critical to understanding the profound interconnectedness of the UFS. Modifying the functioning of one node in this interconnected web is likely to have repercussions in all of the others. Sound decision-making requires an understanding of these effects; any shortcuts in the process will likely lead to more difficulties at the implementation stage.

These are recommendations for establishing a robust outreach process:

1) **Designate one person at the key city agencies as the point of contact, and with the authority, to deal with freight issues**. The designation of such a "freight person" is a highly recommended first step that will likely have a significant impact. Over time, that person will gain a deep understanding of the functioning of the UFS, get to know the key individuals in the business, and develop a network of contacts that could prove useful throughout the process. Equally important, the industry's varied agents will know whom to contact for information, a welcome advantage when trying to navigate complex institutional environments.
2) **Create an Industry Advisory Group (IAG)**. An IAG is designed to be a forum for the discussion of UFS issues that meets several times a year, or when the need arises. The IAG could provide city agencies with vital industry feedback on key issues, and on policies and programs that the city agencies want to pursue. However, it is important to ensure that the IAG reflects the overall composition of the industry. Shippers, carriers, and receivers of the key industry sectors, both small and large, should be involved to provide city agencies with a solid idea about the issues, needs, and expectations of the entire UFS community.
3) **Complement IAG input with targeted outreach efforts**. Since it is unlikely that many business owners or managers could participate in the IAG in a sustained fashion (typically, the majority of attendees of IAG meetings are trade group representatives) it is important to complement the input received. Some suggestions are to: (1) ask the trade groups to disseminate short articles about city initiatives of concern to their members; (2) attend trade group meetings and conferences; and (3) arrange for meetings with key companies to gather input directly.

The recommendations outlined here greatly benefitted the OHD project. The creation of the NYCDOT's Freight Office in 2008 was a turning point in relations with the private sector. For the first time in the NYCDOT's history, a team of professionals was charged with improving the efficiency of UFS operations. By working together towards the solution of problems, relations with the private sector dramatically improved. The OHD also created an IAG which has as its members some of the industry's most influential companies and trade groups such as the Manhattan Chamber of Commerce. The IAG has played a key role in disseminating project information, and recruiting participants. Input from the IAG, complemented with the dozens of IDIs conducted, provided the team with a thorough idea of how best to implement the project.

4.3. Lesson #3: Follow the science

As previously stated, the behaviour of the multitude of participants in the UFS are far from fully understood. The profound heterogeneity in the UFS adds complexity; different businesses in the same industry sector can react very differently to the same public sector policy. Freight behaviour research therefore plays an important role in informing public sector decision-making. The IAG is an obvious place to garner behaviour insight, though more detailed information is needed to draw firm conclusions about the worthiness of a given policy or program.

Typically, a large portion of the research effort is spent trying to understand the behaviour that creates the problem itself. This entails various forms of qualitative and quantitative data collection techniques, including:

1) **In-Depth Interviews (IDIs)**. An important outreach mechanism, IDIs enable extended discussions with key individuals. Typically one hour in duration, IDIs provide a great opportunity to gather insight, probe for additional information, and dynamically change the direction of the discussion, as demanded by the circumstances. IDIs are an ideal mechanism to gain insight from industry leaders, decision makers, and leading researchers. To maximize the usefulness of the IDI it is advisable to: (1) define interview goals and objectives;

(2) draft an interview script to ensure that all the key topics are discussed; (3) pilot test the script, making changes as appropriate; (4) identify the various stakeholder groups, and the list of individuals considered for IDIs; and (5) analyse the results.

2) **Focus groups**. This is an interesting form of qualitative research in which a group of individuals are asked to respond to a given policy question with the assistance of a moderator, who probes different aspects of the subject. In contrast to IDIs, focus groups emphasize the collective discussion of a complex subject, where the moderator steers the discussion in directions likely to reveal important insights. Typically, the participants receive compensation for their participation, and the focus group takes place at a special location. Videotaping of the discussions and observations from a one-way mirror is common. Selectivity bias can be a concern with focus groups because only the opinions of those who participate are captured.
3) **Behavioural surveys combined with discrete choice modelling**. The previous techniques are qualitative in nature, but behavioural surveys intend to produce quantitative estimates of how the UFS would respond to a given policy or program. The heart of the approach is a survey that attempts to capture how specific agents would respond. If the survey focuses on actual behaviour it is a *revealed preference*; if it focuses on hypothetical scenarios it is referred to as *stated preference*. Although significant insight can be gained by descriptive analyses of the data, when the data is used to estimate behavioural models (typically discrete choice models) the analyses are greatly enhanced. Among other benefits, the models identify the interactions among independent variables, and could be used to estimate market shares for the population at large. Moreover they have behavioural interpretation, and their parameters can be statistically tested.

With these forms of information/data gathering, city agencies can gain a solid understanding of how issues are perceived by the various participants in the UFS, as well as their opinions about city-led policies and programs. Once the outreach process is completed, the next step is to act on the insight gained. The input received could be very negative. If so, the city agencies have three alternatives: (1) disregard the input received, and continue with the original idea; (2) modify the original idea to make it more acceptable and ease its implementation; or (3) abandon the idea altogether. Disregarding the input received could be the best solution in cases where the quality of the input is suspect or biased, or deemed unworthy of consideration. However, doing so could also lead to serious political challenges. Modifying the original idea may speed up implementation, though at the cost of some provisions. In cases where the original plan cannot be salvaged, it may be best to simply abandon it. Deciding on the wisest course of action is always a difficult judgment call. However, what is clear to the authors is that any of these outcomes is preferable to trying to implement a policy or program without soliciting any sort of input from the companies that would be impacted. In such a case, the opposition of the private sector is likely to be much stiffer than if they had been consulted.

The behavioural research compiled, using the various forms of outreach discussed in this section, proved invaluable for the OHD project. The research produced estimates of the number of deliveries attracted by the different industry sectors (Holguín-Veras, Jaller, Destro, Ban, Lawson & Levinson, 2011a), and a sense of which sectors were the most inclined to participate (Holguín-Veras, Silas, Polimeni & Cruz, 2007; Holguín-Veras, Silas, Polimeni & Cruz, 2008). The team concluded that the food and retail sectors, given the large number of deliveries they produce, were most likely to participate in OHD. Ironically, the prevailing assumption at the time was that these sectors were opposed to OHD. Further behavioural research revealed factors that could foster their participation: a one-time-incentive, discounts from vendors for OHD, public recognition, business support services, and the availability of a trusted vendor (Holguín-Veras, Wang, Hodge, Sánchez-Díaz, Campbell, Rothbard et al., 2013b). These insights have been used to design a multi-prong strategy to foster participation: the public sector offers the one-time-incentive and public recognition; vendors offer discounts for goods delivered during the off-hours; and the trucking associations provide a trusted vendor certification program.

4.4. Lesson #4: Pilot tests could be a good idea's best friend, or worst enemy

The off-hour delivery pilot test clearly showed how powerful a well-designed pilot test could be. The research previously conducted for the project identified the financial incentives required to produce a shift to off-hours, and

the ideal target groups. The pilot tests—which started after careful selection of participants and coordination with all stakeholders—took place during October-December 2009. Three separate groups of companies (25 receivers, 8 vendors) conducted OHD for a month. Their operations were carefully monitored, and GPS devices were used to track the performance of the participating vehicles.

The pilot test results, and the award ceremony organized by NYCDOT to honour the companies that participated, caught the attention of the popular media, and numerous articles were published about the project, lauding it as a business-friendly sustainability policy (Journal of Commerce, 2010; Wall Street Journal, 2010). This in turn, provided decision-makers with a potent stimulus to push for implementation; and helped publicise the concept among the private sector. A theoretically sound idea thus received crucial confirmation through a well-designed pilot test.

Other benefits of a well-designed pilot test include: (1) it provides a real-life test of a new idea or program; (2) it is an excellent way to identify problems that need to be ironed out before full-scale implementation; (3) it develops new, unexpected insights into overlooked aspects of the concept being tested; and, (4) it can be a great mechanism to attract attention and support from both public sector decision-makers and the private sector. All of these benefits are derived from the fact that a pilot test is perceived as "real-life" while research is "theoretical."

However, a pilot test can fulfil such expectations only if it is adequately designed. A poorly designed pilot could damage the reputation of a new concept, and its proponents, considerably. This is illustrated with a matrix, below, that shows as rows the intrinsic value of an idea or program, and as columns its performance under the pilot test. For simplicity, the corresponding alternatives are classified as "good" or "bad." Table 1 shows the potential outcomes for both a well-designed pilot test in pane (a), and a poorly designed one in pane (b).

Table 1. Potential outcomes of a pilot test

(a) Well designed pilot test

		Pilot test conclusion:	
		Good idea	Bad idea
Idea	Good	100%	
	Bad		100%

(b) Poorly designed pilot test

		Pilot test conclusion:	
		Good idea	Bad idea
Idea	Good	$100\%-\beta_1$	β_1
	Bad	β_2	$100\%-\beta_2$

Pane (a) shows that a good idea tested with a well-designed pilot test is likely to do well; and a bad idea is not likely to perform well. In this situation, the pilot has a high discriminating value as it does not lead to errors in its assessment of the idea's worthiness. The case in pane (b) represents a poorly designed pilot test, where there are non-zero probabilities β_1 and β_2 of the pilot reaching an incorrect conclusion. This could lead to false positives (a bad idea that is deemed worthy) and false negatives (a good idea incorrectly classified as bad).

The implications of these errors are not the same. In the case of a false positive, a bad idea may find its way to implementation, which could lead to wasted resources and effort. At some future point, it is likely that someone will reconsider the decision. In the case of a false negative, a good idea would not have a chance of being implemented. Moreover, this erroneous conclusion may deter practitioners and researchers from ever considering the idea as it may be difficult for researchers to take up a subject that has previously been found unworthy of further consideration.

5. Transferability Questions (or Issues)

Growing interest in the scope for the transferability of urban freight initiatives makes it relevant to consider whether the New York studies can be of value in other cities. A wide review is beyond the scope of the current paper. However it has been possible to consider the case of London and to reflect on whether the lessons learnt in New York have a broader applicability. Table 2 summarizes the operation of the off hours delivery trials in London in early 2012 as the city prepared to host the Olympic Games. In comparison with the New York experience it is clear that these initiatives:

- Covered a wide range of commodity types (and thus the transport operation were also diverse);
- Were mostly small-scale and short-term;
- Provided useful action research about the issues and problems;
- Lacked rigorous monitoring and extensive data collection.

Table 2. Night-time deliveries in London - preparing for the 2012 Olympic Games

Rationale for trials:
The road restrictions required during the 2012 Olympic Games in London were as likely to create some difficulties for freight deliveries. The restrictions required that delivery activity took place outside normal operating hours, and in the most affected locations, deliveries were only possible between midnight and 06:00. The expected increase in night-time delivery work resulted in the need for Transport for London (TfL), London's local authorities, businesses and operators to focus attention on how to facilitate this level of activity with minimum disruption to local residents.

Developing a code of practice
TfL developed a code of practice in partnership with the Freight Transport Association and the Noise Abatement Society that provided guidance for how best to minimize noise disturbance when carrying out night-time deliveries (Transport for London, 2012a). The code is relevant to all sectors receiving and making deliveries and consists of three parts: (i) general guidance about what to consider, (ii) measures to reduce noise at the delivery point, and (iii) measures for drivers. Measures included in the code include consideration of: the use of newer, quieter delivery vehicles and equipment, behavioural changes to reduce noise (especially in relation to goods vehicle drivers and receiving staff at the site), and staff training both in the receiving business as well as in supplier companies and logistics providers.

The trials (pilot projects)
TfL carried out the trials in London in conjunction with businesses, freight operators and local authorities to demonstrate the effectiveness of the code of practice. These trials included a variety of sectors including retail, hotels, bars, restaurants, drinks suppliers, and waste collectors. The trials were written-up and made available as case studies (Transport for London, 2012b). In each of the trials, a working group was established which comprised relevant staff from the businesses involved, their logistics providers, and Environmental Health Officers from the local authority. Each of the businesses participating in these trials altered their delivery schedules, choosing delivery times between 22:00 and 06:00. All staff from the business and their suppliers who were involved in the trial received training so that they could follow the code of practice. Before each trial began, TfL carried out an audit of the point of delivery to identify potential noise sources associated with delivery and unloading activity. The local authority also carried out on-site auditing during the trial to monitor the behaviour of drivers and staff receiving deliveries, and to check that the code of practice was being followed. Noise monitoring equipment was installed for the trial period so that any incidents resulting in complaints from residents could be analysed. The trial period during which the delivery times were changed and the code of practice followed ranged from one to four weeks in most cases. The noise monitoring results were not published in the case studies. No complaints were received from residents during the trials. The trials were used as the basis for more extended off hours deliveries during the 2012 Games period. The results of these more extended operations are the subject of on-going discussion although no central monitoring and data collection was carried out.

Source: Lammgard and Browne (2012)

Despite these differences it is also clear from the pilot work that the fundamental tenets developed from the research in New York can be seen to apply in London. Thus it is possible to confirm the importance of: understanding behaviour (i.e. it is not simply a matter of technology and regulations); working closely with stakeholders (in London the cooperation of relevant local boroughs was important). In New York it was also clear that the economic conditions involved and the role of market forces was a critical element within the development

of the off-hour delivery initiatives. However, in London the importance of market forces has not been fully explored. There had been a number of discussions over the years about the opportunity for off-hour deliveries in London with a few trials being completed. The increased pressure on road capacity and loading space, arising from changes to loading times on the main road network during the Olympics, provided the impetus for the trials in 2012. The full analysis of costs and benefits has not been carried out.

Four of the lessons learned in New York have been discussed in an earlier Section of the paper:

- Make sure there is a market failure;
- Listen to and engage stakeholders in the solution of problems;
- Follow the Science;
- Pilot tests could be a good idea's best friend, or worst enemy;

In the London context it can be seen that these lessons are relevant but the issue is complicated. As noted above the renewed willingness to try off-hours delivery was triggered by an external event and not by a comprehensive analysis of market failure. The importance of stakeholder engagement was certainly as important in London as in New York. The New York experience of following the science has been partially achieved in London where the trials are now being reviewed to see what further lessons can be learned but it could be argued that more monitoring and data collection could have been done and that this was a missed opportunity. The value of pilot tests together with the inherent potential risk is also a lesson that can be seen in London. Some of the off hours deliveries did result in complaints about noise. However, the evidence in London suggests that pilot tests are a good way to explore the possibilities and to see what can be achieved and overall the initiatives taken can be considered successful.

6. Conclusions

The complexity of the urban freight system (UFS) cannot be underestimated: a highly interconnected web of economic agents conducting activities that produce multiple impacts—positive and negative—on economic competitiveness, quality of life, sustainability, and environmental justice. Such complexity, and the real possibility that public sector interventions could have unintended negative consequences, clearly suggests that city agencies must proceed carefully but firmly to address UFS problems. Market failures that lead to economic inefficiencies, and their contributing factors, must be well understood before workable solutions can be developed. Stakeholder outreach and research is essential to identify the best solutions to the problems identified. Understanding the system, and gaining insight into how the agents involved would react to a policy or program will help city agencies chart effective courses of action. The paper identifies pilot tests as very useful tools that, because of their "real-life" applications and connotations, help to eliminate from consideration programs that are unworkable, and to garner support for good programs. To provide the full measure of their potential benefits pilot tests, must be properly designed with the backing of solid research; otherwise they can lead to erroneous conclusions that could discredit a good idea, or allow a bad idea to be implemented.

Taken together, these conclusions highlight the complexity of the UFS, and the need to understand its functioning well in order to move it towards greater sustainability. Ironically, the factors that give the UFS its complexity (the multiplicity of agents and impacts) also make it an important subject of practice and research. The central question of the Off Hour Delivery Program was how to engage all involved in a constructive, multi-stakeholder problem-solving approach; this difficult goal remains the 'Holy Grail' of urban freight policy.

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